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PRODUCTION

P R O C E E D I N G S

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EFFECT OF DIFFERENT NITROGEN FERTILIZATION LEVELS ON MAIZE FORAGE YIELD AND QUALITY

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Abstract: The optimal nitrogen input is very important factor to achieve high crop yields at lower costs of production on farms. The aim of this research was to estimate the effects of different nitrogen levels (0, 60, 120 and 180 kg ha^{-1}) on forage yield and quality green mass in two maize hybrids ZP 666 and NS 6030. Field experiment was conducted on dry land farming at the Institute for Animal Husbandry Belgrade-Zemun in 2013. The tested hybrid NS 6030 had significantly higher ear height (EH), number of leaves (NL), buffering capacity of green mass (BC) and water soluble carbohydrates (WSC) and significantly lower dry matter content (DM) and crude protein content (CP) than hybrid ZP 666. Nitrogen levels have significantly effect on plant height (PH), NL, forage yield (FY), rain use efficiency (RUE), N use efficiency (NUE), CP, BC and WSC. PH and RUE did not differ between treatments fertilized with 60, 120 and 180 kg N ha^{-1}. Maximum NL and FY observed at 120 kg N ha^{-1}, CP at 180 kg N ha^{-1}, BC at control and NUE and WSC at 60 kg N ha^{-1}. NUE was significantly decreased with increased N rate from 60 to 180 kg ha^{-1}. NUE significantly depends on the availability of water, as indicated by the correlation coefficient between these parameters. Studied hybrids are suitable for ensiling. N rate of 120 kg N ha^{-1} can be recommended for growing studied hybrids in order to achieve high yields and quality of forage.

Key words: maize hybrid, N rate, forage yield, forage quality.

Introduction

Maize is used for human food, animal feed and as industrial raw material. In Serbia, about 80% of the total production of maize is used for feeding livestock. Maize grain can be used as feed for all farm animal species, while the silage or green fodder for ruminants (dairy and beef cattle, sheep and goats). Many positive parameters make maize a very good crop to ensile, such as high production of green mass per unit area, energy content of dry matter and quality of biomass *(Mandić et al., 2013)*. *Mandić et al. (2017)* report that in Province of Vojvodina average forage maize yield over longer period (2000-2015) was 22.7 t ha^{-1} and varied from 11.8 t ha^{-1} (2000) to 31.8 t ha^{-1} (2010). Also, their study shows that 43% of variation in maize forage yield could be explained by rainfall variability, while 57% by maize genetics, technical factors and other climatic factors. Their results indicated that forage maize yield had strong positive relationship with amount of rainfall during the growing season and average monthly rainfall for May and August. On the other hand, *Randjelovic et al. (2011)* report that amount of rainfall in June, July and August are important for maize biomass production. Yield of maize depends on the genetic potential, but climatic factors and nutrients has important role in rapid achieve their genetic potential. Generally, intensive maize production is based on the use of mineral nitrogen fertilizers, because nitrogen is a essential nutrient for plant growth, development and reproduction and affects the plant processes *(Mandić et al., 2016)*. Deficiency of nitrogen leads to loss green color in plants, because lower production of chlorophylls and proteins. This leads to lower photoasssimilate production and thus in lower green matter conversion. In this sense, *Jakelaitis et al. (2005)* concluded that genotypes with high NUE have greater capacity to assimilate CO_2 and synthesize carbohydrates in the photosynthesis, resulting in a higher biomass accumulation and grain yield. Maize requires large amounts of nitrogen inputs in order to produce large quantities of biomass. However, application of high level of N fertilizer may have negative effect on the environment, because nitrogen can be lost through soil erosion and runoff and can lead to contamination of ground and surface water. Therefore, nitrogen management in agriculture aims at achieving high crops and minimal N losses. *Amin (2011)* points that nitrogen frequently limits yield and plays an important role in forage quality of crops. *Zhao et al. (2005)* points that the nitrogen deficiency significantly reduces the yield because it is the main element for the synthesis of amino acids, nucleic acids and some organic acid and is necessary for plant growth. Many researchers report that the nitrogen fertilizer strongly affects the maize forage yield and quality, i.e. forage yield increases with increasing nitrogen level. So, *Cheema et al. (2010)* observe that an increase in the fertilizer nitrogen level increases the plant height, stem thickness, leaf area, leaf area index, dry matter accumulation; net assimilates ratio and yield per hectares. *Safari et al. (2014)* report that the highest values of plant height, stem diameter, crude protein, protein yield and forage yield of maize cultivar SC 704 are recorded at 150 and 225 kg N ha^{-1}. *Reddy and Bhanumurty (2010)* report that the highest values of green fodder yield, dry matter yield and crude protein of maize are recorded at 240 kg N ha^{-1}. *Almodares et al. (2009)* conclude that the highest values for biomass and protein content and lowest soluble carbohydrates and fiber contents of maize are recorded at an urea rate of 200 kg ha^{-1}. According to *Karasu et al. (2009)*, the highest forage and dry matter yield of maize are recorded in application of 300 kg N ha^{-1}. *Eltelib et al. (2006)* stated that nitrogen improves vegetative growth, FY and CP of forage maize. *Sheaffer et al. (2006)* report that increasing N rates from 0 to 200 kg ha-1 increases grain yield, whole plant dry matter yield and forage crude protein content of maize.

The aim of this paper was to estimate the effects of various nitrogen levels (0, 60, 120 and 180 kg ha^{-1}) on forage yield and quality in two Serbian maize hybrids of FAO 600 maturity group (ZP 666 and NS 6030).

Materials and methods

Field experiment was carried out in dry land farming at the trial field of the Institute for Animal Husbandry, Belgrade-Zemun (44° 49′ 10″ N, 20° 18′ 45″ E; 88 m a.s.l.), as a completely randomized design in four replications. The plot size was 16.8 m^2. Two maize hybrids FAO 600 maturity group (ZP 666 and NS 6030) were grown during 2013, at four N fertilization levels (0, 60, 120 and 180 kg N ha^{-1}). Preceding crop was winter wheat. Maize was planted on April 8^{th}. Plant density was 64900 plants per hectare. Mineral nutrition *KAN* (27% N) was applied on May 15^{th} when maize had from three to five expanded leaves (V3-V5 growth stage). The standard cultivation practice was applied.

The soil type was a calcareous Chernozem with pH in H_2O 7.18, 9.53% organic matter, 4.1% humus, 0.24% total N, 13.04 mg NH_4^+-N kg^{-1} and 4.12 mg NO_3^--N kg^{-1}. The P_2O_5 and K_2O were 5.03 and 14.1 mg 100 g^{-1} soil, respectively.

Climate diagram according to Walter and Lieth showed that in 2013 (total season rainfall 223 mm) drought periods were in April, when maize was at the initial stage of growth i.e. germination stage and early seedling growth, from late June until the harvest, i.e. from intensive growth of the stem to the milk-wax stage (Figure 1). The summer was dry and very hot. The wettest month was May with an average of 104.4 mm of rainfall. July was the driest month with rainfall of 2.9 mm. August was the hottest month with an average temperature of 25.3°C. On hot summer days the air was very dry. Generally, in 2013, the climatic conditions were unfavorable (heat stress and drought).

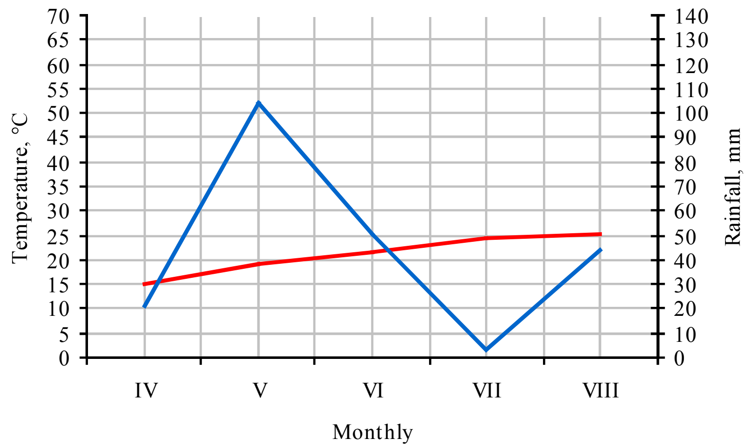

Figure 1. Climate diagram according to Walter and Lieth in the 2013 for Zemun, Serbia.

Plant height (PH), ear height (EH) and number of leaves per plant (NL) were recorded for 10 plants per each subplot. Maize hybrids were harvested during the second half of August at three-quarters milk line stage. Plants from each sub plot were cut on height 20 cm and chopped using maize forage combine harvester, and forage yield (FY) was measured. The FY was converted into t ha^{-1}. Rain use efficiency (RUE) was calculated according to formula FY/total seasonal rainfall (t ha^{-1} mm^{-1}) and N-use efficiency (NUE) according to formula FY/N applied (t forage mass kg^{-1} N applied). The dry matter (DM) was determined as the difference in the mass before and after the drying to constant mass in an oven at 105°C. The crude protein content (CP) was determined according to Kjeldahl *(AOAC 1990)*, buffering capacity (BC) according to method of *Playne and McDonald (1966)* and water soluble carbohydrate content (WSC) according to Luff-Schoorl method.

Data were processed using analysis of variance (ANOVA) using STATISTICA version 10. The significance level was set at $P \leq 0.05$ and $P \leq 0.01$ while differences between traits means were assessed using Duncan's Multiple Range Test at $P \leq 0.05$ level. The relationships between studied parameters were analyzed with simple Pearson correlation coefficients.

Results

Results of ANOVA indicated that hybrid had highly significant effect on EH and NL (Table 1). Hybrid NS 6030 had significantly higher EH (75.6 cm) and NL (10.7) than hybrid ZP 666 (63.8 cm and 10.1, respectively). Hybrid NS 6030 had lower PH (211.5 cm) and higher FY (32.26 t ha^{-1}) and NUE (0.26 t forage mass kg^{-1} N applied) than hybrid ZP 666 (215.2 cm, 30.62 t ha^{-1} and 0.25 t forage mass kg^{-1} N applied, respectively), but these differences were not significant.

Table 1. Hybrid and nitrogen fertilization level effects on maize traits, rain use efficiency and N use efficiency

Factor	PH	EH	NL	FY	RUE	NUE
	Hybrid (A)					
ZP 666	215.2 ± 6.7	63.8^{b} ± 5.9	10.1^{b} ± 0.4	30.62 ± 3.6	0.14±0.02	0.25 ± 0.12
NS 6030	211.5 ± 10.1	75.6^{a} ± 7.2	10.7^{a} ± 0.4	32.26 ± 3.7	0.14±0.02	0.26 ± 0.13
F test	ns	*	*	ns	ns	ns
	Nitrogen level, kg ha^{-1} (B)					
0	197.8^{b} ± 7.7	65.8 ± 7.1	10.1^{b} ± 0.4	25.86^{b} ± 5.2	0.11^{b} ± 0.10	0^{d}
60	214.9^{a} ± 8.4	68.5 ± 9.0	10.4^{b} ± 0.4	31.46^{b} ± 4.0	0.15^{a} ± 0.14	0.55^{a} ± 0.06
120	223.2^{a} ± 16.9	76.2 ± 15.2	10.8^{a} ± 1.1	36.56^{a} ± 1.1	0.16^{a} ± 0.15	0.30^{b} ± 0.04
180	217.6^{a} ± 9.7	68.2 ± 12.4	10.3^{b} ± 0.4	31.88^{b} ± 5.5	0.14^{a} ± 0.13	0.18^{c} ± 0.03
F test	**	ns	*	**	**	**
AxB	ns	ns	ns	ns	ns	ns
M	213.4	69.7	10.4	31.44	0.14	0.26

PH: plant height (cm); EH: ear height (cm); NL: number of leaves per plant; FY: forage yield (t ha^{-1}); RUE: rain use efficiency (t ha^{-1} mm^{-1}) and NUE: N use efficiency (t forage mass kg^{-1} N applied). Means followed by the same letter within a column are not significantly different according to Duncan's Multiple Range test ($p \leq 0.05$). *, **Significant at the 0.05 and 0.01 probability levels, respectively; ns: non-significant.

The nitrogen fertilization level had highly significant effect on NL, and very significant on PH, FY, RUE and NUE. However, results showed that PH and RUE did not differ between treatments fertilized with 60, 120 and 180 kg N ha^{-1}. The maximum PH (223.2 cm) and RUE (0.16 t ha^{-1} mm^{-1}) were recorded at 120 kg N ha^{-1}. Application of 120 kg N ha^{-1} gave significantly higher NL (10.8) and FY (36.56 t ha^{-1}) as compared to control (10.1 and 25.86 t ha^{-1}, respectively), 60 kg N ha^{-1} (10.4 and 31.46 t ha^{-1}, respectively) and 180 kg N ha^{-1} (10.3 and 31.88 t ha^{-1}, respectively). The N fertilization level (60, 120 and 180 kg ha^{-1}) had highly significant effect on NUE (0.55, 0.30 and 0.18 t forage mass kg^{-1} N applied, respectively) compared to control. NUE was significantly higher at 60 kg N ha^{-1} than 120 kg N ha^{-1} and 180 kg N ha^{-1}.

It was found that there is no significant interaction effect between hybrid and nitrogen level for parameters described in table 1.

Very strong positive correlation was found for FY with RUE (r = 0.88), table 3. Strong positive correlations were found for FY with NL (r = 0.63**) and NL with RUE (r = 0.62**). Moderate positive correlations were found for PH with EH (r = 0.47**), RUE with NUE (r = 0.59**) and FY with NUE (r = 0.41*). Weak, low positive correlations were found for PH with RUE (r = 0.40*) and NUE (r = 0.36*), PH with NL (r = 0.27^{ns}) and FY (r = 0.27^{ns}), and EH with NL (r = 0.26^{ns}). Very weak to negligible correlations were found for EH with FY (r = 0.02^{ns}), RUE (r = 0.04^{ns}) and NUE (r = 0.08^{ns}), and EH with NUE (r = 0.08^{ns}).

Table 2. Pearson correlation coefficient (*r*) between studied traits of two maize hybrids (ZP 666 and NS 6030 and four N fertilization levels (0, 60, 120 and 180 kg N ha^{-1})

	PH	EH	NL	FY	RUE
EH	0.47**				
NL	0.27^{ns}	0.26^{ns}			
FY	0.27^{ns}	0.02^{ns}	0.63**		
RUE	0.40*	0.04^{ns}	0.62**	0.88**	
NUE	0.36*	0.08^{ns}	0.27^{ns}	0.41*	0.59**

*, **Significant at the 0.05 and 0.01 probability levels, respectively; ns: non-significant.
PH: plant height; EH: ear height; NL: number of leaves per plant; FY: forage yield; RUE: rain use efficiency and NUE: N use efficiency.

Results of ANOVA in Table 3 showed that hybrid had highly significant effect on DM, CP, BC and WSC of the green forage mass. Hybrid ZP 666 had significantly higher DM (501.4 g kg^{-1}) and CP (g kg^{-1} DM) than hybrid NS 6030 (413.6 g kg^{-1} and 62.5 g kg^{-1} DM, respectively). Contrary, hybrid ZP had significant lower BC (38.5 meq 100 g^{-1} DM) and WSC (20.1 g kg^{-1} DM) than hybrid NS 6030 (43.0 meq 100 g^{-1} DM and 51.1 g kg^{-1} DM, respectively).

The nitrogen fertilization level had highly significant effect on CP, BC and WSC. Results showed that level of 180 kg N ha^{-1} lead to higher content of CP (98.6 g kg^{-1} DM) compared to other nitrogen treatments. CP did not differ between treatments fertilized with 0 (69.7 g kg^{-1} DM), 60 (71.8 g kg^{-1} DM) and 120 kg N ha^{-1} (78.5 g kg^{-1} DM). In treatment with 60 kg N ha^{-1}, BC was significantly lower and WSC significantly higher compared to other nitrogen treatments.

The interaction of hybrid and N fertilization level had highly significant effect on BC and WSC.

Table 3. Hybrid and nitrogen fertilization level effects on the quality green forage mass

Factor	DM	CP	BC	WSC
	Hybrid (A)			
ZP 666	501.4^{a}	96.8^{a}	38.5^{b}	20.1^{b}
NS 6030	413.6^{b}	62.5^{b}	43.0^{a}	51.1^{a}
F test	**	**	**	**
	Nitrogen level, kg ha^{-1} (B)			
0	428.7	69.7^{b}	42.7^{a}	42.0^{b}
60	473.4	71.8^{b}	38.5^{d}	51.8^{a}
120	449.5	78.5^{b}	41.6^{b}	26.5^{c}
180	478.5	98.6^{a}	40.2^{c}	22.3^{d}
F test	ns	**	**	**
AxB	ns	ns	**	**
M	457.5	79.7	40.8	35.6

DM: dry mater (g kg^{-1}); CP: crude protein content (g kg^{-1} DM); BC: buffering capacity (meq 100 g^{-1} DM) and WSC: water soluble carbohydrates (g kg^{-1} DM). Means followed by the same letter within a column are not significantly different according to Duncan's Multiple Range test ($p \leq 0.05$). *, **Significant at the 0.05 and 0.01 probability levels, respectively; ns: non-significant.

Discussion

Significant differences were recorded among maize hybrids for EH and NL. Hybrid NS 6030 had significantly higher EH than hybrid ZP 666. Ear height is very important trait for harvest of maize and the ears need to be at the same height within a population. If the ear height is greater, ear may bend the stem or break, but if it is lower, this further complicates harvesting and has a negative impact on yield because of more ear drop during harvest. Accordingly, the hybrid NS 6030 has fewer losses of ears during ensiling. *Zsubori et al. (2002)* report that environmental conditions and agronomic factor, such as plant density, fertilization, pests and diseases, influence the expression of EH. EH is a very important trait that is considered necessary in maize and is related to morphology, lodging, and yield *(Li et al., 2014)*. *Rao et al. (2014)* conclud that optimal PH and EH are critical parameters for improving plant density to maximize the utilization of fertilizer, moisture and photosynthetically active radiation. Generally, dry stress during stem elongation stage (in the second half of June) reduces the PH and EH, especially in hybrid NS 6030, which in the favorable climatic conditions has a PH of 300 cm and EH of 110 cm *(Jocković et al, 2010)*. The higher air temperature and lower amount of rainfall in this period reduce the stem cell expansion. Water deficit caused by drought slows down stem growth, and elongation of internodes is more inhibited. The result is that the internodes are drastically shorter. Also, *Mandić et al. (2015)* reported that lower amount of rainfall and the higher air temperature in June reduced the stem cell expansion. The NL depends on the genetic basis of hybrid. Hybrid NS 6030 has significantly higher NL than hybrid ZP 666. Also, *Mandić et al. (2015)* report that hybrid NS 6010 has significantly higher NL than hybrid ZP 684. In both researches, results show that hybrids of maize developed at Institute of field and vegetable crops, Novi Sad, have higher NL than hybrids developed at Maize Research Institute, Zemun Polje. On the other hand, PH, FY, RUE and NUE show no significant differences among studied hybrids, indicating their similar behavior in the environment conditions. Hybrid NS 6030 has higher FY for 1.64 t ha^{-1} than hybrid ZP 666, but the difference is not significant. Water resources in the Republic of Serbia are limited that's why for stable maize production rain use efficiency (RUE) is very important. The genotypes with improved RUE are particularly beneficial under low rainfall conditions. In our studies it is interesting that both hybrids have the same value for RUE (0.14 t ha^{-1} mm^{-1}). Also, hybrids ZP 666 and NS 6030 have similar values for NUE (0.25 and 0.26 t forage mass kg^{-1} N applied, respectively). Contrary, *Hokmalipour et al. (2010)* report significant variation in NUE among different maize genotypes, while *Cui et al. (2009)* conclude that the interaction between genotypes and nitrogen greatly influence NUE in maize.

Generally, the amount of rainfall and mean monthly air temperatures were not favorable for the production of maize. Drought periods were at the beginning of the growing period (sowing date), at the stage of intensive growth of the stem in second half of June, at the stage of flowering in July and at the stage of grain filling in August. Even short drought stress in the vegetative stage of maize can reduce PH, leaf area development and dry matter content of maize *(Çakir, 2004)*. Summer drought limits forage production by reducing stem growth and ear size. Ears were short with a small number of grains due to poor pollination. Also, *Mandić (2011)* shows that drought stress in August reduces the grain weight per ear, 1.000 grain weight and grain yield. Therefore, unfavorable climatic conditions contribute to low forage mass of maize. High FY was obtained in years with well distributed rainfall from June to August *(Mandić et al., 2015).*

PH, NL, FY, RUE and NUE were significantly affected by N fertilizer treatments. PH and RUE increased with increasing N rate from 0 to 120 kg ha^{-1}, while further increase of N rate to 180 kg ha^{-1} decreased the PH and RUE. However, there was no significant difference between the N rates of 60, 120 and 180 kg N ha^{-1}. Similar to *Amin (2011)*, our results indicate that increase in plant height is a result of increasing the length of internodes because nitrogen stimulates growth. The plants used N during active cell division to form building protein for cell elongation *(Iqbal et al., 2006)*. This effect is higher with applying N fertilizer than without N fertilizer. EH increased with increasing N rate from 0 to 120 kg ha^{-1}, and then decreased with the further increase of N rate to 180 kg ha^{-1}. However, there was no significant difference between the N rates. The highest NL and FY were recorded at 120 kg N ha^{-1} while the lowest value recorded at 0 kg N ha^{-1} which was statistically at par with 60 kg N ha^{-1} and 180 kg N ha^{-1}. Nitrogen fertilizer had stimulatory effect on stem elongation and leaf emergence of maize. Also, the increase in the NL could possibly be ascribed to the fact that nitrogen increases plant growth and height and this resulted in more nodes and internodes and more production of leaves. *Amin (2011)* report similar results. Nitrogen is a component of protoplasm, proteins, nucleic acids, chlorophyll and plays a vital role in vegetative phases of crop growth. Thus, *Safari et al. (2014)* conclude that nitrogen uptake increases with the increase in nitrogen fertilizer, and given in mind the role of nitrogen in the synthesis of chlorophyll and hence the process of photosynthesis and carbon dioxide assimilation leading to enhanced growth (plant height, stem diameter and number of leaves). Generally, forage yield is a function of growth parameters. The application of the nitrogen dose of 120 kg ha^{-1} stimulates vegetative growth by increasing the PH and NL, and thus the biomass (forage mass). *Witt et al. (2008)* point that NPK fertilizer application is the most important factor required for increasing fodder yield of maize. *Hassan et al. (2010)* have concluded that 140 kg N ha^{-1} has the most positive influence on stem diameter, leaf area index, green fodder yield and total dry matter of maize hybrid Akbar. According to them, this is the optimum nitrogen rate for maize fodder production. *Ali and Anjum (2017)* recommend that 180 kg N ha^{-1} is most economical strategy for obtaining best quality green and dry matter fodder maize yield. In compared to control, NUE was significantly higher at 60, 120 and 180 kg N ha^{-1}. The lower NUE (0.18 t forage mass kg^{-1} N applied) was recorded at 180 kg N ha^{-1} as a result of N loss in ecosystem. The lower NUE is characterized by a relatively low N output in forage mass, and relatively high N input. On the other hand, the higher values of NUE indicate the deficiency of the nutrient. In our case, application of 60 kg N ha^{-1} showed the highest NUE (0.55 t forage mass kg^{-1} N applied). Also, *Bernardi et al. (2011)*, *Amanullah (2014; 2016)* report that NUE decreases with increasing N rates. Results of *Cancellier et al. (2014)* show that for every kg of N applied in soil, the maize plant produces 264.1 kg of green mass.

DM, CP, BC and SS were significantly affected by hybrids. Hybrid ZP 666 had significantly higher DM and CP than hybrid NS 6030. Contrary, Hybrid ZP 666 had significantly lower BC and SS than hybrid NS 6030. Also, *Cox and Cherney (2001)*, *Sheaffer et al. (2006)*, *Bernardi et al. (2011)* and *Safari et al (2014)* conclude that N fertilizer increases whole plant CP content. In our results, nitrogen application of 180 kg N ha^{-1} gave the highest CP as compared with the other nitrogen rates. Generally, increasing content of CP with application of nitrogen, result is role which nitrogen has in the protein synthesis. The BC was significantly lower and WSC significantly higher in treatment with N rate of 60 kg ha^{-1} than other N treatments. This showed that maize hybrids have high sugar content and low buffering capacity at fertilization level of 60 kg N ha^{-1}. *Bijelić et al. (2015)* have found similar values of chemical composition of maize forages before ensiling on various N doses. Generally, forage mass of studied maize before ensiling meets the criteria for ensiling because of its low buffering capacity. *Cox and Cherney (2001)* and *Sheaffer et al. (2006)* reported that increasing N rate effects on silage maize quality components were inconsistent.

Conclusion

Selection of suitable genotypes is important factor for production of high FY. However, climatic factors and nutrients have important role for rapid achievement of genetic yield potential in maize hybrids. Hybrid NS 6030 had significantly higher EH, NL, BC and WSC and significantly lower DM and CP compared to hybrid ZP 666. Accordingly, the hybrid ZP 666 had a better quality of green mass; however both hybrids are suitable for ensiling. Results showed that PH, EH, NL, FY and RUE significantly increased with increase in fertilizer N rate to 120 kg ha^{-1}. Further increasing the N rate decreased values of these parameters.

Contrary, increasing N level from 60 to 180 kg N ha^{-1} significantly decreased the NUE. The NUE depends of the water availability. Nitrogen fertilization increased CP, but had less consistent effect on other forage quality parameters. Maize hybrids have high sugar content and low buffering capacity at fertilization level of 60 kg N ha^{-1}. Generally, the superiority N rate of 120 kg ha^{-1} may be attributed to the increase FY and quality. Also, results indicate that quality of maize green mass would be helpful in the identification and selection of genotypes for ensiling.

Uticaj različitih nivoa đubrenja azotom na prinos i kvalitet silokrme kukuruza

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Rezime

Optimalan unos azota je veoma važan faktor za postizanje visokih prinosa useva uz niske troškove proizvodnje na farmama. Cilj ovog istraživanja bio je procena efekta različitih nivoa azota (0, 60, 120 i 180 kg ha^{-1}) na prinos i kvalitet krme dva hibrida kukuruza ZP 666 i NS 6030. Poljski ogled je izveden u suvom ratarenju u Institutu za stočarstvo, Beograd-Zemun u 2013. godini. Hibrid NS 6030 imao je značajno veću visinu klipa (VK), broj listova (BL), puferni kapacitet (PK) i koncentraciju vodorastvorljivih ugljenih hidrata (VUH) i značajno niži sadržaj suve materije (SM) i sadržaj sirovog proteina (SP) od hibrida ZP 666. Nivo primenjenog azota značajno utiče na visinu biljke (VB), BL, prinos krme (PK), efikasnost korištenja padavina (kiše) (RUE), efikasnost korišćenja azota (NUE), SP, PK i VUH. VB i RUE nisu se razlikovali između tretmana đubrenih sa 60, 120 i 180 kg N ha^{-1}. Maksimalni BL i PK zabeleženi su na 120 kg N ha^{-1}, SP na 180 kg N ha^{-1}, PK u kontroli i NUE i VUH na 60 kg N ha^{-1}. NUE se značajno smanjuje sa povećanjem doze azota od 60 do 180 kg ha^{-1}. NUE značajno zavisi od dostupnosti vode, na šta ukazuje koeficijent korelacije između ova dva parametra. Ispitivani hibridi su pogodni za siliranje. Stopa azota od 120 kg ha^{-1} se može preporučiti za povećanje prinosa i kvaliteta krme kukuruza.

Ključne reči: hibrid kukuruza, stopa N, prinos krme, kvalitet krme

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